Coastal Benthic Optical Properties (CoBOP) of Coral Reef Environments: Effects of Changes in the Spectral Quality and Quantity of the Underwater Light Field on Productivity and Fluorescence Yields of Hermatypic Corals

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LONG-TERM GOAL

My principal goal is to understand the mechanistic basis for changes in the flourescent signatures, both host and algal symbiont, of corals. Changes in the spectral quantity and quality of visible and ultraviolet radiation will have effects of the quantum yield of photosynthesis and affect the fluorescent signatures of the algal symbionts as will changes in the temperature of the surrounding seawater. Since the reef environment is very dynamic, the challenge is to understand what environmental factors are responsible for the the greatest variability in these fluorescent optical signatures at small to large scales and understand sufficiently to model them over spacte and time.

OBJECTIVES

The Coastal Benthic Optical Properties (CoBOP) project is directed at understanding the optical properties of coastal benthic communities in general, and in particular, coral reefs. Coral reef communities are coastal areas of high water transparency which make them ideal systems to study optical signatures originating from the benthos. The scientific objectives of my project are: to understand the relationship between primary productivity and chlorophyll fluorescence in hermatypic corals and identify the temporal and spatial scales of variability in this optical signature.

APPROACH

Studies were conducted in August 1995 on Long Key Reef at 10 m depth in the Dry Tortugas, Florida and 18 m off of Loggerhead Key, Dry Tortugas in June 1996. During

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The shape of the modeled *P-I* relationship for *Montastraea faveolata* and *Montastrea cavernosa* from 18 m are very similar to 10 m productivity results with the expected decline in maximum productivity with increasing depth. For bothe depths the *P-I* curve for *M. faveolata* shows that the available irradiance is insufficient to saturate photosynthesis but does saturate photosynthesis for *M. cavernosa*.

The spectral absorption coefficient, normalized to chlorophyll, for both *M. faveolata* and *M. cavernosa*has the typical peaks associated with chlorophyll absorption. Additionally, samples of *M. cavernosa* exhibit lower spectrally corrected absorption coefficients. The fluorescence data at 685 nm shows and inverse relationship between productivity and fluorescence suggesting that the fluorescence yields are affected by the physiological status of these corals. Additionally, for both 10 and 18 m, the minimum quantume requirements are higher for *M. faveolata* compared to *M. cavernosa*. Both species of coral have high concentration of UV absorbing compounds at 18 m although only half as much as conspecifics at 10 m depth.

IMPACT/APPLICATIONS

The major implication for this work is that chlorophyll fluorescence yields appear to be directly related to the photosynthetic state of these benthic organisms, and their depth of occurrence. Additionally, for corals at the same depth the fluorescence yields are very different. These differences in fluorescence yields suggests fundamental, potentially genetic, differences in the phenotypic features of the symbiotic dinoflagellates, or zooxanthellae of corals. The differences for these conspecifics will need to be taken into consideration, as well as differences between much more divergent species, when developing models to understand the variability in optical sitgnatures.

TRANSITIONS

The data collected from the 1996 and 1996 field seasons is presently being prepared for publication. In that process other members of the CoBOP team will be able to utilize a complete data set on two species of coral at two depths to look at factors influencing the optical properties of those corals.

RELATED PROJECTS

Charlie Mazel-ONR, CoBOP

Chalie Yentsch-ONR, CoBOP

Dave Phinney-ONR, CoBOP

Paul Falkowski-ONR, CoBOP

REFERENCES

M. P. Lesser, C. Mazel, C. Yentsch, and D. Phinney. Benthic Optical Properties of Coral Reefs: Effects of Changes In The Spectral Quality and Quantity of the Underwater Light Field on Productivity and Fluorescence Yields of Hermatypic Corals. (Manuscript in preparation for Limnology and Ocenaography)

http://nightsea.mit.edu/research/cobop/lsi/lsi.html